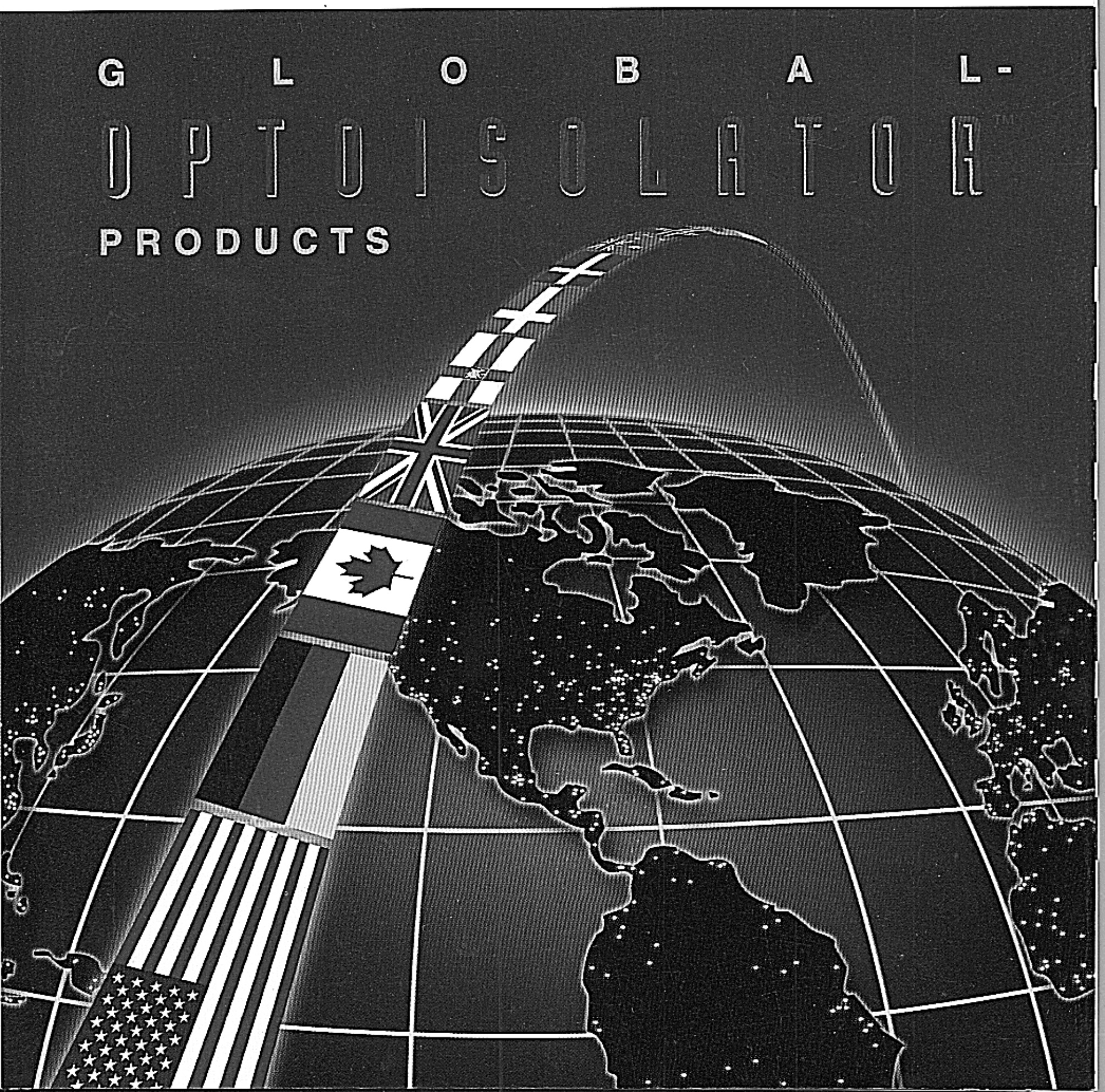
MOTOROLA

DL118/D
REV 5

Optoelectronics

Device Data



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Section 1

Introduction

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General Product Information

The Motorola Optoelectronic Division produces optoisolators and power optoisolators.

Technology leadership in optoelectronic products is demonstrated by state-of-the-art 600 volt, zero-crossing triac drivers (MOC3163); the industry's only standard high temperature Darlington isolator (MOC8080) and the industry's only supplier of standard products with 7500 Vac peak isolation voltage.

The broad optoisolator line includes nearly all the transistor, Darlington, triac driver and Schmitt trigger devices now available in the industry. Motorola optoisolators come in the standard 6-pin DIP package, and the new small outline SOIC-8 style, surface mount package. Each device is listed in the easy-to-use Selector Guide (Section 3) and a detailed data sheet is presented in a succeeding chapter.

The Motorola Spectrum of OPTOISOLATORS

Optoelectronics is a special branch of semiconductor technology which has come into prominence during the last fifteen to twenty years. Solid state optoelectronic components have proven to be versatile design tools, offering the engineer inexpensive, reliable alternatives to their bulky predecessors.

Solid state light emitting diodes (LEDs) in the visible portion of the electromagnetic spectrum have virtually eliminated the usage of incandescent lamps as panel indicators. Infrared emitters and silicon photodetectors find application in optoisolators. Optoisolators are being designed into circuits previously using small mechanical relays and pulse transformers.

Over the years, solid state optoelectronic technology has advanced dramatically. Research into new and improved materials and processing techniques have led to devices having higher efficiencies, improved reliability, and lower cost.

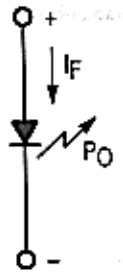

Figure 1. The LED

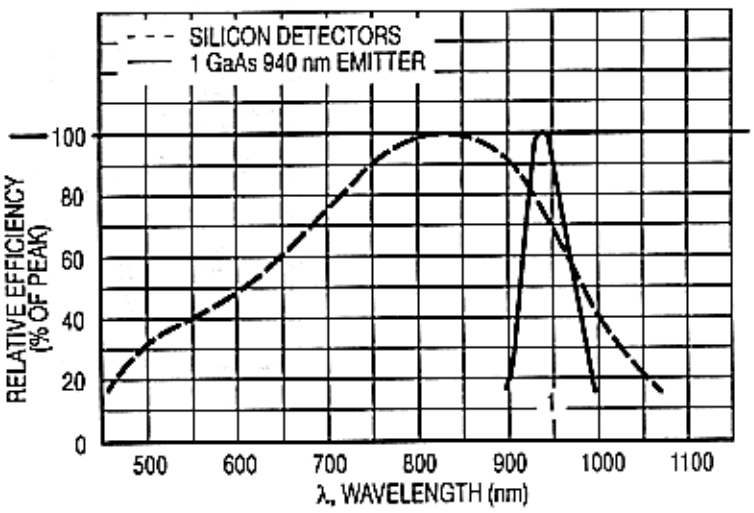

Figure 2. Emissivity versus Wavelength

Emitters

Early emitters, both visible and infrared, suffered from low power output and rapid power output deterioration (degradation) when compared to present day devices. Emitter chip materials, commonly referred to as III-V compounds, are combinations of elements from the III and V columns of the periodic chart. The P-N junction is formed by either diffusing or by epitaxially growing the junction. Typical materials used for emitters include gallium arsenide (GaAs) and gallium aluminum arsenide (GaAlAs), among others.

When a forward bias current (I_F) flows through the emitter's P-N junction, photons are emitted. This is shown schematically in Figure 1. The total output power (P_O) is a function of the forward current (I_F), and is measured in milliwatts.

Motorola's optoisolator emitters operate at a wavelength of 940 nanometers (nm). See Figure 2. This encompasses the infrared portion of the electromagnetic frequency spectrum. The 940 nm emitters are the most cost effective. Most all optoisolators, for example, use the 940 nm emitter.

Newly developed materials and refinements in chip processing and handling have led to more efficient and more reliable emitters. New packaging techniques have made low–cost plastic optoisolators possible.

Advances made in LED technology over the years have eliminated many of the problems of early-day devices. Even the problem of degradation of emitter power output over time has been brought to a level which is tolerable and predictable. When coupled to a silicon detector, today's devices can be expected to lead a long and useful life.

Detectors

As emitters have developed over the years, photodetectors have also advanced dramatically. Early phototransistors and photodiodes were soon joined by photodarlington detectors, and then by light-activated triacs. Innovations in design have created devices having higher sensitivity, speed and voltage capabilities. A variety of detectors is shown in Figure 3.

Recent developments in detector technology have led to larger and more complex circuit integration. Photodetectors incorporating Schmitt trigger logic outputs are becoming increasingly popular in applications requiring very fast speed, hysteresis for noise immunity, and logic level outputs.

Future trends point to even higher performance characteristics and higher levels of circuit integration.

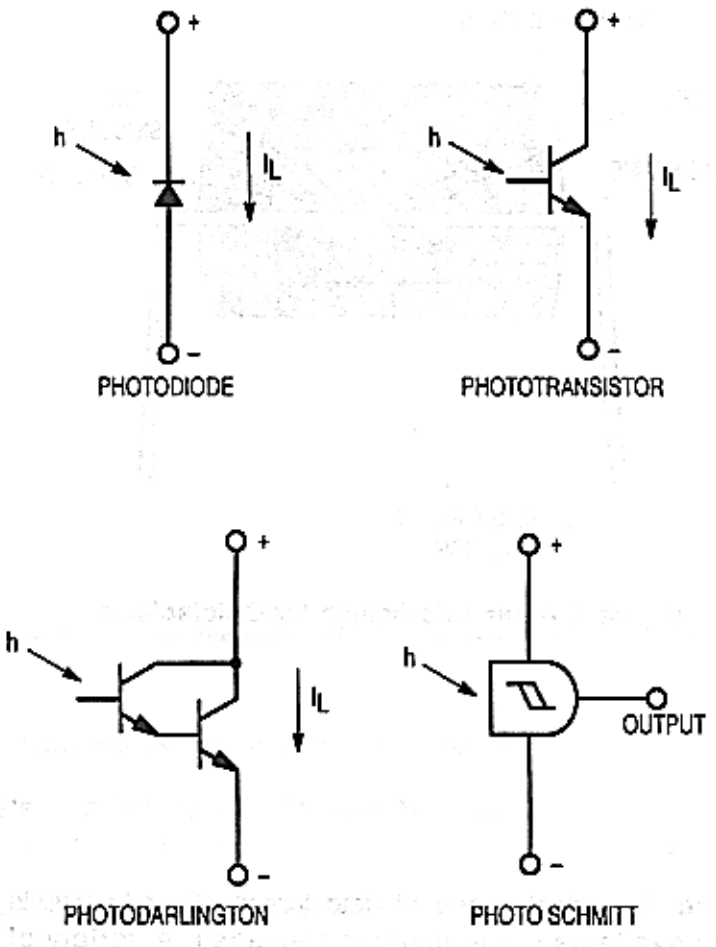

Figure 3. Light Sensitive Detectors

Optoisolators

Optoisolators, a block diagram of which is shown in Figure 4, are devices which contain at least one emitter, which is optically coupled to a photodetector through some sort of an insulating medium. This arrangement permits the passage of information from one circuit, which contains the emitter, to the other circuit containing the detector.

Because this information is passed optically across an insulating gap, the transfer is one-way; that is, the detector cannot affect the input circuit. This is important because the emitter may be driven by a low voltage circuit utilizing an MPU or logic gates, while the output photodetector may be part of a high voltage DC or even an ac load circuit. The optical isolation prevents interaction or even damage to the input circuit to be caused by the relatively hostile output circuit.

The most popular isolator package is the general purpose six-pin DIP, or dual in-line, package. Motorola also offers a small outline surface mountable SOIC-8 package along with 6-pin surface mount leadform options. This offers answers to many problems that have been created in the use of insertion technology. Printed circuit costs are lowered with the reduction of the number of board layers required and eliminates or reduces the number of plated through-holes in the board, contributing significantly to lower PC board prices.

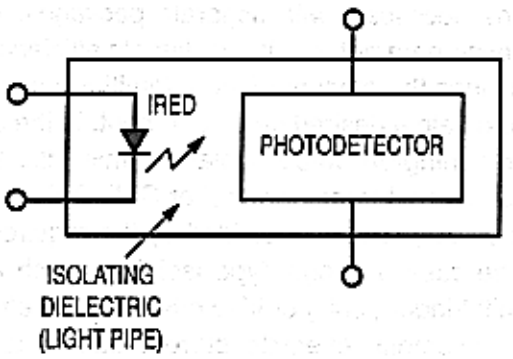

Figure 4. Block Diagram of Optoisolator

Various geometric designs have been used over the years for the internal light cavity between the emitter and detector. Motorola is the industry leader in isolation technology. All 6-pin optoisolators are guaranteed to meet or exceed 7500 Vac (pk) input-to-output isolation. See Figure 5.

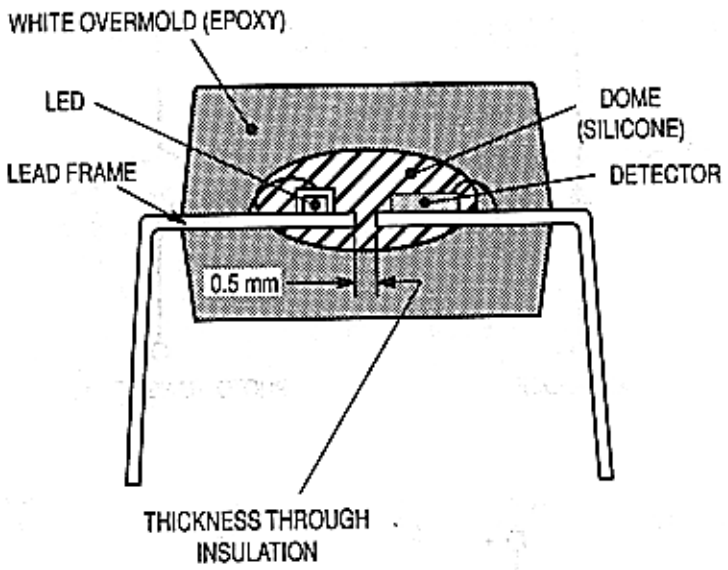

Figure 5. Geometric Design for Optoisolators

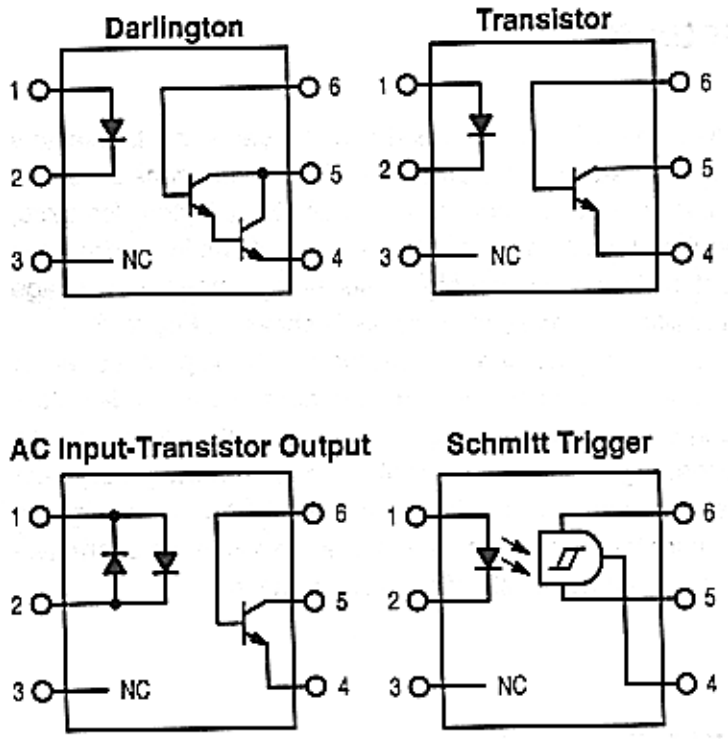

Figure 6. Various Optoisolator Configurations

The wide selection of photodetectors mentioned earlier is also available in the isolator packages. A variety of optoisolators is shown in Figure 6. With the emitters and detectors both sealed inside an ambient-protected package, the user need not be concerned with any of the optical considerations necessary with separate packages. An important operating parameter of the isolator is efficiency. This parameter defines the amount of input (emitter) current that is required to obtain a desired detector output. In the case of transistor or darlington output isolators, this efficiency is referred to as "current transfer ratio," or CTR. This is simply the guaranteed output current divided by the required input current. In the case of trigger-type isolators, such as one having Schmitt trigger (logic) or triac driver output, efficiency is defined by the amount of emitter current required to trigger the output. This is known as "forward trigger current," or I_{FT}.

Efficiency and isolation voltage are two of the most important operating parameters of the optoisolator.

All Motorola six-pin DIP optoisolators are recognized by the Underwriters' Laboratories Component Recognition Program. It should be noted that this recognition extends up to operating voltages of 240 volts ac(rms). Under UL criteria, these devices must have passed isolation voltage tests at approximately 5000 volts ac peak for one second. In addition, Motorola tests every six-pin DIP optoisolator to 7500 vac peak for a period of 1 second. Also, Motorola's six-pin DIP optoisolators are offered in a variety of optional lead form/trim options. See the section on Package Dimensions for more detailed information.

All Motorola 6-pin optoisolators are approved by VDE, the optoisolator standard which is accepted in most European countries. Check the Motorola data sheet section for specific information on approvals to various VDE norms.